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环境规制与地区经济增长：  
基于地方分权的理论与实证研究

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(英文):

**Environmental Regulation and Economic Growth:**  
**Based on the theoretical and Empirical Research**  
**under the Background of Local Decentralization**

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## 摘要

自改革开放以来,中国经济和社会发展取得了很大的进步,被称之为“中国的奇迹”。其中,政府在经济起飞过程中的作用不可或缺。尤其是1994年分税制改革,中央政府逐渐把经济决策权下放给地方政府,充分调动其积极性,主要体现在地方政府拥有足够的财政自主权,能够对地方经济发展负责,从而形成“增长型政府”经济发展模式。但是,它也带来诸多问题。其中,随着地区经济快速增长,环境污染问题已经敲响警钟,引起各方的广泛关注。尽管对环境与增长之间权衡关系已经成为近年来学术研究前沿和热点问题,但是较为系统研究两者关系仍存在诸多不足。因此,本文将以地方分权为研究背景,通过理论分析和实证研究,揭示环境规制和经济增长之间的内在机制和影响因素,并结合环境规制政策工具选择的理论与实践,为地方政府乃至国家经济与环境协调发展提供决策与参考。

首先,在理论方面,本文力图将分权制度、环境规制、技术进步与经济增长联系起来,建立一个在地方分权背景下环境规制与经济增长的统一的理论分析框架,修正并拓展两阶段动态博弈理论模型,使之适用于环境规制与经济增长的纳什均衡分析,得到如下结论:(1)政府实施较为严格环境标准将降低被规制的企业产量。然而,在考虑技术创新条件下,政府实施环境规制对不同企业类型作用不同。对于技术创新型企业来说,政府实施严格环境规制,企业污染治理当期支出上升,治污预期支出减少,刺激企业提高产量;对于非技术创新型企业来说,情况正好相反。(2)当不考虑环境技术创新条件下,分权体制下地方政府间环境规制竞争策略取决于由污染引起社会损失曲线的速率的变化情况。当社会损失曲线速率低于临界点时,地方政府间环境规制倾向于“逐底竞争”形态;当社会损失曲线速率高于临界点时,地方政府间环境规制倾向于“差异化竞争”形态。(3)在考虑技术创新条件下,在单一企业从事研发活动条件下,作为对相邻地区企业污染治理预期支出下降的反应,本地政府会通过加强环境标准引致提高企业污染治理预期支出的差异化竞争策略。在双企业从事研发活动条件下,本地政府环境规制引致企业治污支出竞争策略取决于由污染引起社会损失预期曲线速率的变化。当社会损失预期曲线速率低于临界点时,地方政府间环境规制倾向于“标尺竞争”形态;当社会损失预期曲线速率高于临界点时,地方政府间环境规制倾向于“差异化竞争”形态。

其次，在实证研究中，通过对环境规制与经济增长的特征性描述，运用空间面板模型识别出地方政府间环境规制竞争形态，得到如下事实与结论：（1）中国经济高速发展背后付出较大环境代价。虽然在落实科学发展观以来，环境污染得到一定程度遏制的，但是总体来看，环境污染问题较为严重。此外，中国环境污染规制强度具有较为明显地区差异，依赖于考察污染物度量指标。总体来看，发达地区环境污染规制强度要高于欠发达地区。（2）总体来看，在 2004-2009 年间，并没有证据支持政府间环境规制“逐底竞争”策略，相反呈现出“差异化竞争策略”形态。从地区来看，东部地区和东北地区政府间环境规制竞争表现为“差异化竞争”策略；中部地区表现为环境规制“自上而下标尺竞争”；西部地区没有明显环境规制竞争策略。（3）环境规制强度对地区经济增长具有一定促进作用。其中，东部和中部地区的作用更为明显；东北地区 and 西部地区作用较弱。（4）地区经济增长率的空间溢出效应具有地区差异。东部地区表现在地理上邻近性的空间效应更大些，西部地区表现在人口规模相似地区间空间效应更大些。

再次，在模型拓展应用方面，提出环境规制、空间溢出与技术进步的待检验的理论假说。随后，运用地级市以上城市面板数据，采用 DEA-Malmquist 指数测度出生产技术进步指数，通过构建空间面板计量模型，实证检验技术进步的“环境规制效应”与“空间溢出效应”，得到如下结论：（1）在 2003-2009 年间，全国工业全要素生产率平均增长率为 9.39%，其中，技术效率和技术进步共同推动经济增长。但是，它存在明显的地区差距。与此同时，工业生产技术指数同样也表现出较为明显地区差异。西部地区工业技术进步指数最高，达到 3.9%，其次为东北地区为 3.1%，而东部地区却是最低，仅为 1.76%。（2）总体来看，政府提高环境规制强度，将促进地区生产技术进步，支持“波特假说”，但是，东部地区环境规制在技术进步扮演的作用更大些，而西部地区环境规制在技术进步中所起的作用还较弱，中部其次。东北地区仅有在经济发展水平相似地区间环境规制强度对生产技术进步具有一定的正向作用，但是作用较弱。（3）技术进步的空间溢出效应存在较为明显的地区差异。东北地区表现在人口规模相似地区间空间效应更大些；中西部地区表现在地理上邻近性的空间效应更大些。（4）对影响技术进步的最大因素存在明显地区差异。影响东部和中部地区技术进步的最大因素为企业规模；影响东北和西部地区技术进步的最大因素为政府干预经济强度。

最后，讨论环境规制工具的选择、效应分析与实践，得到以下结论：（1）中国经历了由“标准控制—排污收费—环境标志”环境政策的发展阶段，政府由环境政策的推动者转变为环境政策的引导者和推动者。（2）企业更乐意接受传统环境规制政策工具；而对于政府开征环境税、理顺资源价格等市场型环境规制工具的接受度较低。在市场型环境规制工具中，珠三角、长三角、环渤海地区企业接

受比例明显最高。(3) 在通常情况下, 环境税实施后, 经济增长和环境保护之间存在一种权衡, “增长双重红利” 效应通常不成立, 但在一定条件下可以获得“福利双重红利” 效应; 环境税改革在不同参数条件下“环境红利效应” 有所不同, 它不仅依赖于行业的技术类型情况, 而且依赖于政府环境意识参数。(4) OECD 国家在实施环境税中积累了较为丰富经验: 环境税的种类繁多、税负比重高; 环境税实行有差别的税率; 实行专款专用制度; 税收减免和返还制度。由于中国区域经济发展差距, 不同地区对环境税改革接受程度也有所不同。因此, 本文认为应采取审慎的态度, 循序渐进推进环境税改革, 优化财政治理环境手段。在此基础上, 我们提出未来环境规制管理中, 大力推进科学环保政绩考核体制、着力健全环境法制化管理、稳步推行环境税改革制度、重点实施差异化的环境规制政策。

本论文的创新主要体现在以下两个方面:

第一, 理论建模的创新。改进并拓展了环境规制与经济增长的两阶段动态博弈模型, 对此作了如下四点拓展: (1) 建立含有地方分权、环境规制、经济增长、技术创新等要素的统一理论分析框架, 探讨的四者之间的内在互动关系, 以及它们如何内生地影响政府间环境规制竞争形态。(2) 通过设置在环境规制约束下企业治污成本函数, 体现出环境规制对企业治污成本的传导机制, 从而探索出环境规制约束下企业治污成本的竞争形态; (3) 较为全面推导出不同参数条件下地方政府间环境规制的“逐底竞争策略”、“差异化竞争策略”、“标尺竞争策略”形态。(4) 放松技术中性的假设, 引入企业治污预期成本的概念, 探索出在环境规制约束下企业污染治理预期支出竞争各种形态。上述的探索在现有文献研究中是缺乏并且不够深入。

第二, 实证研究的创新。在实证研究中, 运用地级市以上的城市面板数据, 运用空间面板计量方法检验若干个理论命题, 创新之处体现在如下三点: (1) 在空间权重矩阵的设置上, 本文不仅采用地理加权、而且采用经济、人口加权空间权重矩阵的设置。并且, 在灵敏性检验中, 本文还采用经济—地理和人口—地理嵌套式空间权重矩阵方法。(2) 采用空间面板 *Durbin* 模型实证分析环境规制的竞争形态存在较为明显地区差异。东部和东北地区环境规制“差异化竞争”形态、中部地区环境规制“自上而下标尺竞争”、西部地区环境规制竞争不明显。(3) 运用空间面板滞后和误差模型识别出生产技术进步的“空间溢出效应”与“环境规制效应”存在较为明显的地区差异。与其他地区相比, 东部地区环境规制对生产技术进步影响更大些; 地区间经济活动的空间溢出效应大小, 取决于空间权重矩阵设定。

**关键词:** 环境规制; 经济增长; 技术进步; 空间计量; 环境税

## Abstract

Since reform and opening up, China has made a great leap in economy and social development, known as the Chinese Miracle, among which government plays an indispensable role. Especially after Tax System Reform in 1994, central government gradually decentralized economic decision-making to local governments in order to fully mobilize their enthusiasm, which is mainly reflected in the fact that local governments began to have sufficient financial autonomy in local economic development, thus forming a growth-oriented government mode in economic development since then. However, it also faces a lot of problems, among which environmental issues have already sounded the alarm, catching a widespread concern. Although in recent years trade-off between environment and growth has become an increasingly great concern in academic field, there is still insufficiency in a more systematic study of it. Therefore, under the background of fiscal decentralization, through theoretical modeling analysis and empirical research, and combined with theories as well as practices in instrument choices of local governments in environmental regulations, this dissertation explores internal mechanism of and factors upon the trade-off, in order to promote regional economic growth, thereby providing guidance for regional governments and even the nation in coordinating economic and environmental development.

First, theoretically, the dissertation tries to establish an integrated analysis framework of environmental regulations and economic growth under local decentralization, extends the model of a two-stage dynamic game theory, and applies it to solve the Nash equilibrium between them, by connecting local decentralization, environmental regulations, technological progress and economic growth,. The following conclusions are obtained: (1) Stricter environmental standards by governments will decrease production of enterprises. However, with technological innovation, different effects will appear in different types of enterprises. Stringent environmental regulations will stimulate technologically innovative companies to increase production as their current pollution control expenditure is on the rise and expected to decrease, while the opposite is true for non-technologically innovative companies. (2) With no technological innovation, under the background of local decentralization, environmental regulation competition strategies among local

governments depend on rate change in social loss function curve caused by environmental pollution. When the rate is lower than the critical point, strategies tend to be “Race to Bottom”; when the opposite happens, strategies tend to be “Differentiated Competition”. (3) With technological innovation, for single enterprise, local governments will adopt such differentiated competition strategies as strict environmental standards to increase enterprises’ expectation on pollution control expenditure in response to lenient ones executed by neighbor local governments. For double enterprises, companies’ pollution control expenditure competition strategies derived by local governments’ environmental regulations hinge on rate change in expected social loss function curve caused by pollution. When the rate is lower than the critical point, strategies tend to be “Yardstick Competition”; when the opposite happens, strategies tend to be “Race to others”.

Secondly, empirically, after examining characteristic facts of the relationship between environmental regulations and economic growth, by using spatial panel Durbin model to identify strategies by local governments, the dissertation makes the following conclusions: (1) Some relatively huge environmental cost is hidden in rapid economic development in China. Since the implementation of Scientific Outlook on Development, environmental pollution, to some extent, has been curbed, Overall, it is still severe. Secondly, there is an obvious disparity among regions in environmental pollution regulations, depending on indices adapted to measure pollutants. In sum, regulations in developed regions are more stringent than in backward ones. (2) Generally, , there is no strongly evidence to support “Race to Bottom” strategies during 2004-2009, conversely, “Race to others” strategies get support. From regional perspective, there are “Race to others” strategies in Eastern and Northeastern regions, “Yardstick Competition” in Middle region and no strategies in Western region. (3) Environmental regulations have a certain beneficial effect on economic growth, with more obvious effect in Eastern and Middle regions, less in Northeastern and Western regions. (4) The spatial spillover effect of economic activities exists in all four regions but has a different range. Spatial effect in Eastern region with geographic-weight matrix is more obvious, while that in Western region with population-weight matrix is more obvious.

In addition, in model extension, theoretical hypothesis on environmental regulations, spatial externalities and technology progress is proposed. Then by using empirical data of prefecture-level (and above) cities during 2003-2009, adopting

DEA-Malmquist index to measure production and technological progress, the dissertation establishes spatial panel data model to empirically test “environmental regulation effect” and “spatial spillover effect” of national and regional technological progress, and makes the following conclusions: (1) During 2003-2009, average growth rate of total factor productivity of industries in China is 9.39%, among which technological efficiency and technological progress promote economic growth together. But it has an obvious regional disparity. Meanwhile, the same is true in industrial production and technology index, with Western region the highest reaching 3.9%, Northeastern region the second 3.1%, Eastern region the lowest 1.76%. (2) As far as the nation is concerned, stringent local environmental regulations promote production and technology progress, supporting “Porter Hypothesis”, however, there is an obvious regional characteristic in effect of environmental regulations upon production and technology progress, with Eastern region the most obvious, Middle the second, and West the weakest, while a positive but weak effect in Northeastern region only happens in a similar degree of regulations among local governments. (3) There exists a spatial spillover effect of technological progress in all four regions, with different degrees, depending on structures of spatial weight matrices. Spatial effect in Northeastern region with population-weight matrix is more obvious, while that in Middle and Western regions with geographic-weight matrix is more obvious.(4) There are also regional disparities in major factors upon technological progress, with Eastern and Middle regions company size matters most, but with Northeastern and Western regions government intervention counts.

Finally, tool selection, effect and practises of environmental regulations are discussed, and the following conclusions obtained: (1) China has gone through a three-stage development in environmental policies from “standard control to sewage charges to environmental labeling”, illustrating that government’s role has changed from a promoter to a guide. (2) Enterprises in China are more willing to embrace traditional environmental regulations, while less to accept market-oriented environmental regulations, such as implementing environmental taxes and rationalizing resource prices, but Pearl River Delta, Yangtze River Delta, Bohai Rim area are exceptions. (3) Usually, after implementation of environmental taxes, there is a balance between economic growth and environmental protection, and double dividend effect of growth does not apply, however under certain circumstances, it does apply. With different parameters, environmental dividend effects derived from

environmental taxes reform are different, depending on distribution of different types of industries and governments' environmental consciousness parameter which exerts great influence upon optimal environmental tax, output and welfare. (4) OECD countries have accumulated rich experiences in implementation of environmental taxes: multiple types of environmental taxes, high tax rates, and differential tax rates, system of earmarking, tax relief and rebate system. On the basis of it, management of environmental regulations, scientifically environmental protection in the future should be promoted actively in achievement assessment of local governments, management of environment according to laws perfected effectively, institution of environmental taxes carried out by piloting first and with several stages second, differentiated policies implemented stably and gradually.

The innovation of this paper is mainly reflected in the following points:

On the one hand, theoretical modeling. Two-stage dynamic game theory model is improved and extended in the following four aspects: (1) by connecting fiscal decentralization, environmental regulations, technological progress and economic growth, the dissertation tries to establish an analysis framework of environmental regulations and economic growth and applies it to solve the Nash equilibrium between them. (2) it is more comprehensively derived that "Race to Bottom" strategies, "Race to Up" strategies, and "Race against Others" strategies will show up in environmental regulation competition under different conditions among local governments. (3) Environmental regulation transmission mechanism is displayed in model construction, which has not been done in previous researches. Different types of competitions in pollution control costs of enterprises among regions under different parameters are derived by taking enterprises' pollution control costs, caused by environmental regulations, as an endogenous variable. (4) Technology neutral assumptions are further relaxed, concept of expected pollution control costs of enterprises introduced, all kinds of competitions in expected pollution governance expenditure of enterprises explored. These explorations are missing in current literature.

On the other hand, empirical studies. By using data of prefecture-level (and above) cities, taking spatial econometric tools and extended in the following three aspects:

(1) As far as setting different spatial weights are concerned, we use not only the geographic-weight, but also economic-weight and population-weight. In addition, we use the nested weight for both geographic-economic and economic-weight to identify the sensitivity analysis. (2) we use the spatial Durbin models to identify the different



types of competition strategies in environmental regulations among different regions and their impact upon economic growth. There are “Race to others” strategies in Eastern and Northeastern regions, “Yardstick Competition” in Middle region and no strategies in Western region. (3) Spatial spillover effect and environmental regulation effect of production and technology progress among regions are explored. Eastern region are the most obvious of it, Middle the second, and West the weakest, while a positive but weak effect in Northeastern region only happens in a similar degree of regulations among local governments.

**Key words:** environmental regulation; economic growth; technological progress; spatial econometric; environmental taxes